

V-22 OSPREY



The V-22 Osprey is a tilt-rotor vertical/short takeoff and landing (VSTOL), multi-mission aircraft developed to fill multi-Service combat operational requirements. The MV-22 will replace the current Marine Corps assault helicopters in the medium lift category (CH-46E and CH-53D). The Air Force requires the CV-22 to provide a long-range VTOL insertion and extraction capability and to supplement the Special Operations Forces MC-130 aircraft. The tilt-rotor design combines the vertical flight capabilities of a helicopter with the speed and range of a turboprop airplane and permits aerial refueling and worldwide self-deployment.

Two 6150 shaft horsepower turboshaft engines drive two 38-ft diameter, 3-bladed proprotors. The proprotors are connected to each other by interconnect shafting which maintains proprotor synchronization and provides single engine power to both proprotors in the event of engine failure. The engines and flight controls are controlled by a triply redundant digital fly-by-wire system.

The airframe is constructed primarily of graphite-reinforced epoxy composite material. The composite structure is intended to provide improved strength to weight ratio, corrosion resistance, and damage tolerance compared to typical metal construction. Battle damage tolerance is built into the aircraft by means of composite construction and redundant/separated flight control, electric and hydraulic systems. An integrated electronic warfare defensive suite including a radar warning receiver, a missile warning set, and a countermeasures dispensing system will be installed.

The ballistic design requirements specify not-to-exceed vulnerable areas for the following threats: 7.62mm API, 12.7mm armor-piercing incendiary (API), 14.5mm API, and 23mm API. Hits could occur at either hover condition or during a 2-g maneuver. Following a hit, the aircraft must be able to complete a 30-minute flight and land vertically.

BACKGROUND INFORMATION

The V-22 is being developed to provide the Marine Corps and Air Force with the capability to conduct assault support and long-range, high-speed missions requiring vertical takeoff and landing capabilities.

Starting with OT-II-A, a total of five periods of OT&E have been conducted. The first three periods of OT&E used test aircraft from the earlier FSD program. The main thrust of these OT&E

periods was ground testing combined with simulation. OT-IID in 1998 was conducted using EMD aircraft numbers 9 and 10, the final two aircraft delivered under the EMD program. OT-IID consisted of 142.6 flight hours conducting operationally realistic missions and the MV-22 was found to be potentially operationally effective and potentially operationally suitable, although unrealistic maintenance procedures and contractor involvement skewed the reliability and maintainability data.

OT-IIE (OPEVAL) of the MV-22 began on November 2, 1999 and finished on July 21, 2000, accomplishing 804 flight hours in 522 sorties. OPEVAL was conducted with five MV-22 LRIP aircraft, aircraft numbers 11 through 15, aboard four Navy ships and at nine locations ashore. One LRIP aircraft was destroyed, and 19 Marines were killed in April 2000 when the aircraft experienced an excessive rate of descent and entered into an aerodynamic phenomenon called vortex ring state.

A waiver request from full-up, system-level live fire testing for the V-22 was supported by DOT&E and granted by the Secretary of Defense on April 25, 1997. An alternative LFT&E plan, approved by DOT&E prior to submittal of the waiver request, included a comprehensive series of ballistic tests of critical components, major assemblies, and aircraft structures. A continuous process of design refinements has been an integral part of the system engineering effort since the start of live fire testing, and several design changes have been made based on the test results.

The effectiveness of the V-22's vulnerability reduction features was demonstrated during the LFT&E program. Numerous vulnerability reduction features were developed or integrated into the design as a direct result of LFT&E, including re-design of the composite spouson fuel tank structure.

TEST & EVALUATION ACTIVITY

DOT&E completed an independent evaluation of test adequacy, operational effectiveness, suitability and survivability, and submitted the required B-LRIP Report to the Secretary of Defense and congressional defense committees in time to support the Milestone III decision planned by the Navy in November 2000. The Navy delayed the Milestone III decision indefinitely after a second fatal V-22 mishap in December 2000. All V-22 flying was halted following the December 2000 mishap and is not expected to resume until spring 2002.

In the wake of two serious mishaps, the V-22 program has restructured the development and acquisition schedule, seeking advice from several independent sources: a Blue-Ribbon Panel appointed by the Secretary of Defense to review the entire program's history and future; an Executive Committee of senior Service officials; and a panel of aeronautical experts from NASA and academia. In addition, the program has consulted closely with DOT&E as plans for future needed testing were developed.

TEST & EVALUATION ASSESSMENT

In the B-LRIP Report, DOT&E concluded that testing had been adequate to determine the MV-22's operational effectiveness, operational suitability, and survivability. However, additional testing is needed to verify correction of deficiencies, the effectiveness and suitability of waived items, and to investigate the phenomenon of vortex ring state. The MV-22 was assessed by DOT&E as operationally effective but not operationally suitable. Results from OT-IIE (OPEVAL) indicate that the V-22 will provide major range, speed, and payload improvements to meet Marine Corps and Special Operations Forces requirements. The V-22 offers significant maneuverability and handling advantages as compared to conventional helicopters; e.g., rapid deceleration upon arrival at a landing zone and rapid acceleration

during departure. When tactics are fully developed, these capabilities should provide substantive advantages in mission accomplishment and survivability. In addition, OPEVAL results indicated that with modified operational procedures, at least some required tasks could be performed despite the downwash experienced in the rotary wing mode, which had been an issue of concern in previous OT&E. The MV-22 met all the key performance parameters specified in the Joint Operational Requirements Document.

Operational testing of the MV-22 did not demonstrate that the MV-22 as configured and tested during OPEVAL is operationally suitable. The MV-22 demonstrated marginal mission reliability, excessive maintenance manpower and logistic support requirements and inadequate availability, interoperability, human factors, documentation, and diagnostics capabilities. In the latter half of OPEVAL, the trends on some key measures of suitability were positive, suggesting that the aircraft has the potential to eventually meet its suitability requirements. Nonetheless, taken as a whole or considering only its improved suitability data from the second half of OPEVAL, the MV-22 failed to meet several important JORD established thresholds. Moreover, the demonstrated results for MV-22 mission reliability, maintainability, and availability were less favorable than the same measures from the fielded CH-46 fleet. The OPEVAL results also failed to confirm the improvements postulated before the test in system reliability and fault diagnostics.

The effectiveness of the V-22's vulnerability reduction features was demonstrated during the LFT&E program. Also, the following vulnerability reduction features were developed or integrated into the design as a direct result of LFT&E: redundant jam-proof actuators; run-dry gear boxes; improved composite wing structure and fuel tanks; dual, tandem swashplate actuators; damage-tolerant ballscrew conversion actuators; dry bay fire protection; self-sealing fuel tanks; and suction fuel system.

Early ballistic tests against the full-Scale development aircraft identified a potentially serious cracking problem following a hit into the composite sponson fuel tank structure. The damage was significantly greater than expected and was accompanied by fires under the fuselage floor and within the cargo/passenger area of the fuselage. The sponson structure was re-designed using a different epoxy resin as well as a revised graphite fiber laydown process and re-tested. The additional tests demonstrated that the cracking was significantly reduced, there were no fires, and repair was within the limits typically used for composite structures.

The general approach to return the V-22 to flight is staged, with high rate of descent (HROD) testing the first order of business after a thorough ground test of the flight control software in laboratories and simulators. As soon as the first aircraft is modified with system safety changes, developmental flight testing will resume; an Operational Assessment will be done in conjunction with early DT&E. After confirmation of the safe flight envelope in the HROD tests, the Navy plans to issue a limited flight clearance to operational V-22 units, which will allow training flights to prepare for a second phase of OPEVAL to address the issues raised in the B-LRIP Report (testing not conducted, waived items, and correction of deficiencies). DOT&E plans to issue a supplement to the B-LRIP Report containing our assessment of test results.

LESSONS LEARNED

The restructuring of the V-22 program, which has substantially delayed getting the V-22 to operational units, was necessary and prudent. The extended development and deficiency correction plans are cautious and appropriate.

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